

THE BEHAVIOUR OF INDIAN GRAY WOLF (*Canis lupus pallipes*) IN CAPTIVITY AT SAKKARBAUG ZOO JUNAGADH, GUJARAT, INDIA

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ABSTRACT

The present study was carried out on the behaviour of Indian gray wolf (*Canis lupus pallipes*) in captivity at Sakkarbaug Zoo, Junagadh, Gujarat, India. The Indian gray wolf is critically endangered species and fall into schedule-1. Total ten wolves of 3-4 years old were observed. Ninety minutes observation was taken every week at morning time. Walking, resting, facial, resting alert, playing, fighting, standing, eating, etc. behaviours were studied. The observations of various behaviour activities of wolves were rerecorded from July 2018 to January 2019. Two different types of behaviours like active behaviour and inactive behaviours observed with two different patterns as 1) Wolf was solo in captivity and 2) Wolf pack in captivity. The time slice method was used. The wolves' activity was registered in each ten minutes, nine times in one and half hour at morning. Twelve types of behavioural activities were recorded in the captive wolves. They were displaying different types of activities. Peaceful sharing of food with one another without competition was found in wolves. The newly born pups and mother were kept in separate cage from other captive wolves' cage for their better survival and growth. When wolf kept solo, it shows monotonous behavior of running and walking as compared to wolves in the pack. This indicates that animal could be under stress.

KEYWORDS: Wolf, Behaviour, Captivity, Solo, Pack & Sakkarbaug Zoo

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INTRODUCTION

The Indian wolf was first studied in 1831 by the British ornithologist William Henry Sykes under the binomial *Canis pallipes*. In the family of Canidae wolves (*Canis lupus*; Sykes, 1831) are found in maximum frequency. The Indian grey wolf was the vast roamer occurring almost in all habitats but mainly confined to remote tracks of arid hilly regions and wide-ranging desert (Roberts, 1997). The grey wolf also inhabits open plains like semi-arid grasslands, scrublands, grazing land etc. (Shahi, 1982). Wolves communicate to each other by different means like sounds, smell, posture, etc. Wolves howl to communicate, celebrate, and to create the illusion (Montanaro, 2012). Wolves were placed in the family of canidae and the genera canis which include species of wolves, jackals, and the domestic dog. The taxonomy and phylogeny of the wolves had been variously explained as including a single species of *C. lupus* (Nowak, 2009) or at most as two species with the second being *C. rufus* (Audubon & Bachman, 1851) as suggested by Goldman, 1937. *C. rufus* to be a subspecies of *C. lupus* (Lawrence & Bossert 1967; Wozencraft 2005), or a modern hybrid species of *C. lupus* and *C. latrans*; Say, 1823 (Reich *et al.*, 1999). The Indian wolf, (*Canis lupus pallipes*) possibly diverged from Grey wolf sub species of wolf, dog clade about four lakh years ago.

Gray wolves resemble the domesticated dog breed of German shepherds or husky in appearance; however, its large skull and teeth distinguish it from other closely related members of the family Canidae (National Studbook of Indian Wolf, Sagno *et al.*, 2017). Coat colour has been usually lighter in summers as most of the fur is shed and only present sparse long hair remains in its body, giving the species a characteristic thin, long-legged appearance (Habib, 2007). Adult wolves can be distinguished from juveniles in the field by their size, behaviour and white markings that develop above the eyes, on the chin and under the throat (Jhala, 2003). In the dog family Leptospirosis disease was harmful to humans as to dogs (Raval *et al.*, 2015).

The front foot had five toes, including a short dewclaw, placed proximal to other four, whereas the hind foot had four toes. The legs were moderately long with digitigrade limb posture; the chest was narrow and keel-like with forelimbs superficially pressed into the chest and elbows turned inward and paws outward (Young *et al.*, 1944). Wolves had long legs and powerful leg muscles, which facilitate tireless travel at a usual rate of 8 km per hour and a running gait of 55 to 70 km per hour (Mech, 1970). The extended rostrum provides an abundant surface of the olfactory organ that allowing the wolf to detect odours of prey at various distances up to 2.4 km in favourable conditions (Mech, 1974). However, a high-resolution genomic analysis of dog breeds showed the potential of molecular studies to capture the structure of genetic differentiation even if it is of very recent origin (Parker *et al.* 2004). Phylogenetic analysis of the D-loop region revealed a high level of polymorphism and homoplasy within and between the canid species (Aggarwal *et al.*, 2006).

During our study, we observed that, when the wolf was alone in the captivity, it was showing the different behavioural patterns. It was continuously under stress because of the constant presence of visitors near the cage. It was unremittingly running in its cage. It was found in more stress. It appeared generally in fearful condition. When any human being moves near its cage, it stops for a few minutes and continuously stares in that person. It was found alert throughout the presence of visitors. In that case, resting behavior was found less frequently. It tries to smell the person if anyone goes near to the cage. Walking, running, facial, standing behaviors were seen in captivity when it was alone.

When the wolves were kept in a pack it showed varied behavioural activities. Wolves had many local names in India like Nar, Varu, Bhedia and Landga. It was a threatened species listed in schedule-1 of the wildlife protection act, 1972. Some time in captivity wolves used to prey on insects. Pups were showing the playful behaviour. Sense of smell after that sense of hearing was most acute of the wolf's senses. Wolf's were sitting vantage point to keep an eye on the surroundings. When wolves used to fight with each other, they were showing their incisors and canine teeth, it was a sign of warning to the attack (Khandal & Khandal, 2018).

Habitat Ecology

The Indian wolf inhabits areas dominated by scrub, grasslands and semi-arid and different pastoral agro-ecosystems (Jhala, 2013); however, in the eastern parts of its range extending across parts were Odisha, Bihar and West-Bengal etc. They were known to inhabit moister low density forested (Shahi, 1982). Indian wolves were similar to other sub-species of gray wolves were territorial animals with their pack size, prey density and size being important for determinants of their home range size (Jhala, 2003). The small body size of Indian wolves allows sustaining themselves on smaller ungulates, lagomorphs and rodents (Habib, 2007).

Social Organization and Behaviour

Wolves were gregarious animals with well-developed social system, with a family being a typical wolf pack (Mech, 1970 & 1999). Adult wolf (parents) guides the activities of the group with a division of labour, the female wolf plays an important role in pup rearing while the male wolf was responsible for foraging and territory maintenance (Mech, 1999). The breeding male and female were responsible for the territory scent marking (Rothman & Mech, 1979). The breeding male wolf was though dominant at all other times were subordinate to a female wolf with pups displaying submissive behaviour, foraging food for her and the pups (Mech, 1999).

Distribution

The subspecies *C. l. pallipes* had a wide distribution range, extending from the India in the east to Turkey in the west, with populations reported from Pakistan, Iran, Iraq, Syria and Israel (Mendelssohn, 1982; Shahi, 1982; Mech & Boitani, 2010). Indian wolf is distributed across the states of Gujarat, Rajasthan, Haryana, Uttar Pradesh, Madhya Pradesh, Maharashtra, Karnataka and Andhra Pradesh. In India, they inhabit scrublands in three bio geographical zones that include the hot desert, the semi-arid zone and the Deccan plateau (Jhala, 2013).

Figure 1 shows the distribution of Indian gray wolf in India and shows the other species of wolf which is distributed in India.

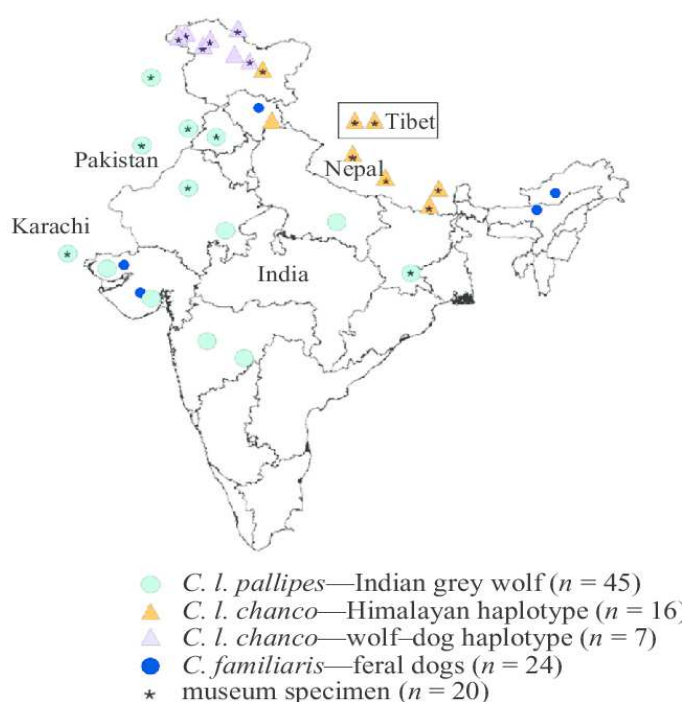


Figure 1: Distribution of Wolf in India

<https://www.researchgate.net/figure/a-Map-of-wolf-distribution-in-the-Northern-Hemisphere-showing-historical-distributions>
 Retrieved on 15-1-2019 from: (Map not to scale)

Numbers of Indian Gray Wolf in Captivity at Sakkarbaug Zoo, Junagadh

Fourteen wolves are present in captivity at Sakkarbaug zoo. Out of this, seven are adult male; five are adult female and two pups born in December. Nine wolves were born in the zoo. Five wolves were arrived from another zoo like Maisur Zoo, Jodhpur Zoo and Jaipur Zoo.

Food and Feeding

The Indian Gray wolf was dependent on blackbuck, chinkara, hare and small mammals. These all species had extensive distribution. Food and feeding differences were seen in wild and in captivity in wolves. In the wild, they were hunted normally at night or sometime in the morning or in the evening (Khandal & Khandal, 2018). Prey items eaten by wolves were identified mostly by using the scat analysis. Mostly contain single prey item (Mayura *et al.*, 2011). Wolves were provided the food in the captivity. Food is given in particular quantity. For Adult the food is given only one time per day. For young ones the food is given two times per day. Quantity of food for young ones was almost same as the adult. Food is given in the evening. In captivity, mutton is given for food at near about 6 or 7 pm to Adult and young ones. For young ones food is given two times, at morning and evening. At morning mixture of milk, egg, biscuit and calcium tablets were given for food at near about 10 am. Competition was hardly observed for food among them. It was observed that wolves preferred to have less quantity of food when their health is not well.

Reproductive Behavior

The Indian gray wolf was the only wolf sub- species that breeds in the winter months. An Indian wolf was breed in winter, with mating occurring sometimes in October - November and was restricted to the dominant pair of the pack (Jhala, 2003). After a courtship that can last from days to months, wolves copulate during an estrous period of 5 to 7 days (Mech, 1974). The gestation period was lasts for 62-63 days and the breeding female was begins excavating a den about 15 days to a month prior to whelping (Mech, 1970). Female gives birth to about 3-6 number of pups. Pups are blind at the time of birth, developing blurred vision by the age of 15 days with most milk teeth are erupting by 3 weeks of age (Mech, 1970). The female remains near the pups for at least 2 months. It had been suggested that parental care behaviour in zoo animals can be easily interrupted at low levels of stress even when other aspects of reproduction are normal (Shepherdson *et al.*, 1998; Wielebnowski, 1998). Providing captive animals with suitable environmental enrichment can promote natural parental behaviours, which in turn enhances breeding success in captive individuals (Shepherdson *et al.*, 1998).

METHODOLOGY

Study Area

The study area was the Sakkarbaug Zoo, Junagadh. Junagadh city is the head quarter of Junagadh district in the state of Gujarat. The city is located at the foot of the Girnar hills and it is 7th largest city in Gujarat. Three distinct seasons winter, summer and monsoon were observed with a tropical wet and dry climate. Gujarat provides a wide and diverse range of habitats (Raval, 2011). Sakkarbaug Zoo is the oldest zoo of Gujarat and India's third oldest zoo. It is famous for breeding *Panther liopersica* and supplies it to other zoos. Sakkarbaug zoo gathers all the serene environs of Junagadh at one place. Sprawling over an area of 84 hectares, Sakkarbaug zoo was open to the public in 1853. People who want to indulge in a three-hour wildlife safari at Gir National Park can visit the Sakkarbaug Zoo as here one can spot Asiatic lions roaming freely in large enclosures. Some of the fauna include wolf, panther, deer, antelope, black buck, and spotted deer, tiger, lion, hyena, etc.

The objective of the Sakkarbaug zoo is to protect the animals in captivity and also to educate the people about the endangered and rare species of the earth. Library of the zoo helps to increase knowledge and give more information about the animals. Timings: 9:00 am to 5:00 pm. Source: <https://www.com/states/gujarat/Sakkarbaug-zoological-garden->

Figure 2 shows the map of India. Figure 3 shows the map of Gujarat. Figure 4 shows the map of Junagadh the location of Sakkarbaug zoo. Figure 5 shows the entrance gate of Sakkarbaug zoo, Junagadh. 21° 53' 99" N and 70°46' 73" E.



Figure 2: Map of India. Source:
<https://www.freemaildatabase.com/product/meghala-free-email-database/>
Retrieved on 15-1 2019. (Map Not to Scale)



Figure 3: Map of Gujarat.
Source: <http://gujaratonline.com/about/map.htm>.
Retrieved on 15-1-2019.(Map Not to Scale)



Figure 4: Map of Junagadh City.
Source: <https://www.google.co.in/maps/vt/data>
Retrieved on 14-1-2019.(Map not to scale)



Figure 5: Sakkaurbaug Zoo Junagadh

The different types of behavioural activities of wolf (*Canis lupus pallipes*) in captivity were observed at Sakkarbaug zoo, Junagadh. The behaviour of fourteen Indian Gray Wolves was studied for a period of seven months. Each wolf was observed for the duration of Ninety minutes, every week. Observations were taken from July 2018 to January 2019. Three seasons were studied monsoon, post monsoon and winter. Fourteen wolves were studied; Male, Female and pups. The ethogram was used to represent the behavioural observations. We used the time slice method to develop an activity budget for the wolves. Standard deviation (SD) and the mean of the behaviours in each category were calculated in minutes of each behavioural event. One way analysis of variance (ANOVA) was conducted to see the

difference in the amount of behaviour activity in wolves.

Behavioural activities were divided into mainly two different types of groups (1) Active behaviour and (2) Inactive behaviour. In the active behaviour, walking, running, standing, playing, fighting, facial, howling, eating, manipulation, orientation and research, excretion were included. In the inactive behaviour resting, sitting, sleeping were included. As far as the ethogram implies, during observation the same category data are introduced into it to separate the categories, The description of different structural levels of behaviour that is shown in Panov (1978): (1) The elementary motional act leads to single change of a body part position or organ; (2) Pose or expressive pattern - several EMAs produced simultaneously or in a rapid sequence; (3) Sequence - behavior chain containing successive units of the second level; (4) Ensemble or activity type (fodder, research and other). Elements of the first, second, third and fourth category i.e., the sequences were registered. In processing the data, the behavior forms were combined into large functional categories (activity type) such as play or aggression or many other types. Several behavior forms were included into the same activity type (Yachmennikova *et al.*, 2011).

Individual Types of Activity

Sleep - an individual sleeps, it is not active; Rest- an individual sits, lies in different poses but does not sleep; Movement - an individual moves around at any type of pace; Feeding - an individual chews foodstuff swallows, transports in a mouth, reserves, and drinks; Excretion and marking - defecation, urination, and scratches; Orientation and research behaviour - alertness, interest, anxiety orientation towards observer - following an observer, sniffing the place where the observer was staying, listening to the observer's movement.

Social Types of Activity

Contact with observer - look for active interaction with observer, approach, and manipulation with his clothes and shoes; consolidation reaction; aggressive facial expression and sounds; Friendly activity - approach with head down swaying, mild wagging, touch nose to nose, licking of angle of lips and lower jaw of another individual, smile corresponds to face expression; Play - activity was registered when any forms of play were observed; Stress reaction - fright, fear, avoidance of a stress factor (an individual lays back its ears, vails, moves on bended legs, there may be a body quiver); usually it was registered on external stimulus.

RESULTS AND DISCUSSIONS

The twelve behaviors of wolves were observed during the study in captivity. Facial behaviour was often used to express emotions. Wolves were showing dominancy and aggression by baring teeth. Wolves were peaceful sharing food with one another. The twelve most common behaviours were observed during whole time period of July 2018 to January 2019. These behaviours were observed: Running, resting, seating, resting alert, walking, fighting, playing, standing, eating, facial, sluggered and smelling. When wolf kept solo, it mostly shows running and walking behavior. Wolves were found eating insects and showing scent roll behaviour.

A significant difference was found in the different type of behaviours. Different kinds of communication of the wolves were observed with the human beings and other wolves or other animals. Unwell wolves were found spending most of their time in resting. Males found to raise their one leg completely during urination. In this study, wolves showed more walking behaviour as compared to eating behaviour. Some small trees, shrubs with bark and leaves, rock piles, small ponds and many other features can increase the possibility to provide a homely atmosphere for wolves. In captivity artificial

things supplement natural habitat to wolves. Lower aggression and stress level shows strong social bonds with each other in a pack.

If we compare our results with a few previous researches, we found that when a wolf was kept solo it shows very less activity than wolves kept in a pack. In wolves, peaceful co-feeding occurred in 83% of trials (Dale et al., 2017). We also found in our study that peaceful co-feeding occurred in wolves. Some types of social behaviours, wolves display in the wild do not occur in a zoo. Wolves may instead show stereotyped behaviour in captivity (Knutson, 2017). For the short period of time we had also studied the behaviour of wolf when it was kept solo. Considerable differences found in between the behaviour of wolf kept in solo and kept in a pack in this study. Wolves born and raised in the wild will ultimately display more aggressive behaviour than wolves born and raised in captivity.

The overall increase in aggressive behaviour can be contributed to several factors, including but not limited to human interaction, feeding habits and pack dynamics (Knutson, 2017). Wolf habituation and food conditioning can also impact the behaviour of wolves (Smith, 2003). The wolves breed once a year and periodicity of reproduction influence the social behaviour, movements and structure of the pack (Packard, 2003). Common investigation of all patterns can be used for illustration and examination of the unevenness of the structure of interconnection and organization of activities. Orientation towards the observer can occur to a lesser extent. Food and marking activities and sleep were rare, components of activity pattern (Yachmennikova et al., 2011). We also found similar results.

Wolves can lose fear of humans by having frequent and increasingly closer contact with them, thus making them less aggressive when encountered with human (Knutson, 2017). Strong bonds promote more sharing in wolves. In the group setting, rank was the primary factor determining feeding behaviour. Each wolf pack members had an equal chance to eat. This is the first evidence that the importance of the social relationship in food sharing is dependent on the feeding context in canids (Dale et al., 2017).

Stereotypes were thought to indicate that an animal's environment was sub optimal and that the animal was suffering from a welfare problem such as stress (Mason, 1991). When the wolf was kept in solo it was in stress that observed in this study wolves also depend upon insects, birds and fruits of some plants. In captivity, natural caves and cavities in the rocks were also present which provide shelter to wolves (Muhammad, 2015). When considering stress in wolves; enclosure size direct relations of this as if there is not a large enough enclosure. In captive wolves average aggression levels towards pack mates are found to be four times higher than a wild pack (White, 2001). Male wolves raise their one leg when they urinate, whereas females merely cock the leg similarly in flexed leg urination (Khandal & Khandal, 2018).

The playful acts of young and sub adult wolves are not just to make them happy; the play may serve as a form of practice and also may help them become more flexible (Khandal & Khandal, 2018). The enclosure design should incorporate sufficient space to facilitate normal movements and a range of natural behaviours (Gunning, 2007). Scent rolling disguises the wolves' own scent for a purpose like predation or maybe more attractive to other wolves (Khandal & Khandal, 2018).

Table 1 shows the various types of behavioural data of Indian gray wolf for seven months. Figure 6 shows the ratio of the number of pattern types composed of activities in July in solo wolf. Figure 7 shows the ratio of the number of pattern types composed of activities in August 2018 to January 2019 in wolf Pack

Table 1: Numbers of Behavioural Activity of Wolves in Different Months

Behaviors	Jul.(min.)	Aug.(min.)	Sep.(min.)	Oct.(min.)	Nov.(min.)	Dec.(min.)	Jan.(min.)
Walking	86	97	108	203	200	121	141
Smelling	40	46	51	132	100	67	50
Running	116	96	88	126	124	131	73
Seating	0	53	91	179	138	100	77
Eating	0	23	14	44	29	37	26
Fighting	0	39	72	96	69	105	47
Playing	0	49	113	127	83	95	86
Standing	63	84	93	180	125	123	69
Slugged	24	28	55	79	82	63	45
Facial	109	78	92	169	125	87	80
Resting	0	34	107	182	219	202	139
Resting Alert	0	23	64	67	74	76	63

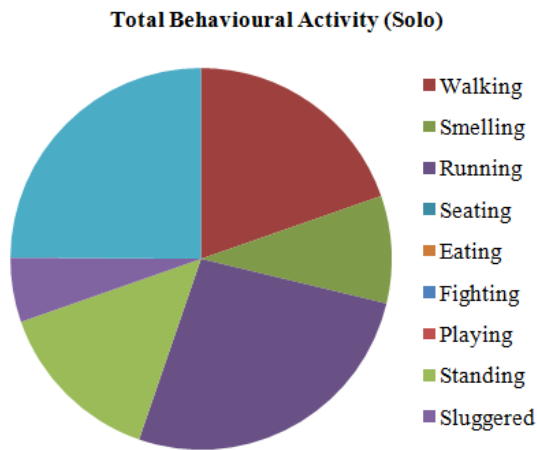
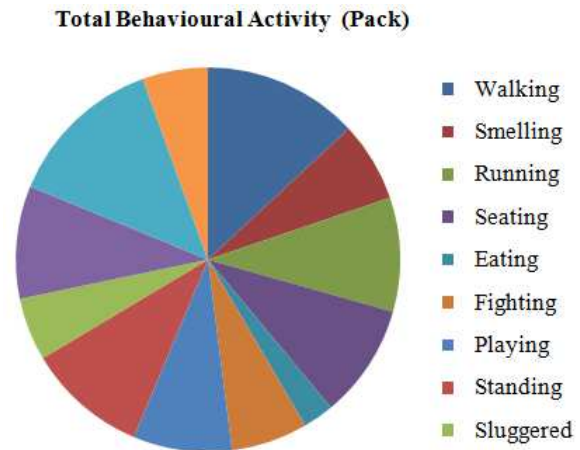
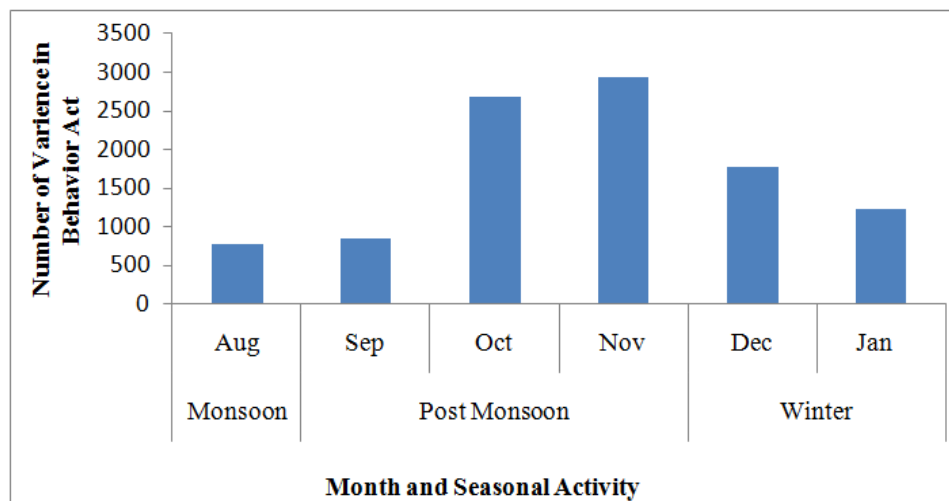
**Figure 6: Ratio of the Number of Pattern Types Composed of Activities of Solo Wolf in July****Figure 7: Ratio of the Number of Pattern Types Composed of Activities of Wolf Pack in August to January****Figure 8: One Way Analysis of Variance for Month and Season**

Table 2 shows the descriptive statistics for the percentage of observations of these twelve behaviours. Figure 9 shows the mean and the SD duration of behavioural activities of wolves in seven months. Figure 8 shows monthly and seasonally one way analysis of variance in the month August 2018 to January 2019. It shows the various changes in the

studied month.

Table 2: Descriptive Statistics for the Percentage Occurrences of the Twelve Behaviours Observed

Behaviour	Total No. of Month	Min.	Max.	Range	Mean	SD
Walking	7	86	203	117	136.57	47.65
Running	7	73	131	58	107.71	22.14
Eating	7	0	44	44	24.71	14.55
Fighting	7	0	105	105	61.14	35.93
Playing	7	0	127	127	79	42.66
Facial	7	78	169	91	105.71	32.54
Resting	7	0	219	219	126.14	84.09
Resting Alert	7	0	76	76	52.42	29.13
Smelling	7	40	132	92	69.42	34.12
Seating	7	0	179	179	91.14	57.66
Standing	7	63	180	117	105.28	40.81
Sluggered	7	24	82	58	53.71	22.90

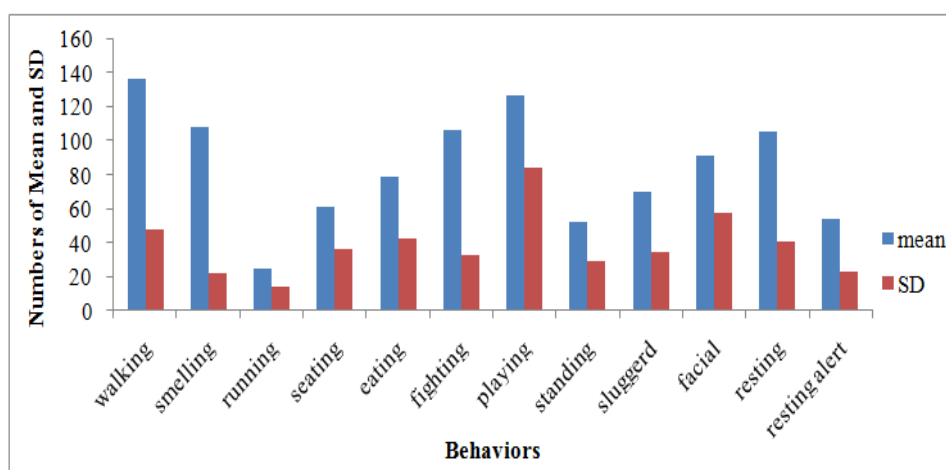


Figure 9: Graph of Mean and SD Duration of Behavioural Activities of Wolves in Seven Month

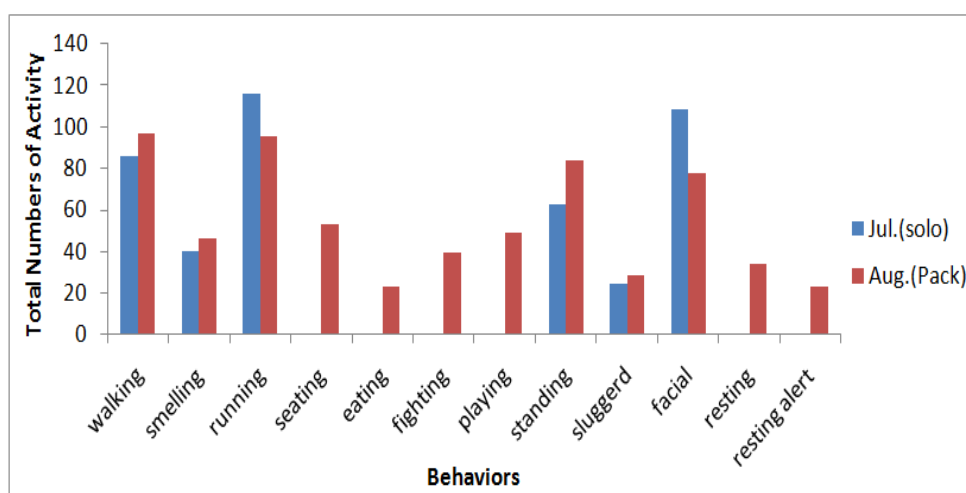


Figure 10: Difference between Behavioural Activities when Kept in Solo and Kept in Pack

CONCLUSIONS

Based on the behavioural observation in captivity, we studied various behaviour patterns. A significant difference was found in the different type of behaviour. This study was focused on a relatively small pack size. The result of this study provides different behavioural patterns like walking, resting, resting alert, eating, fighting, smelling, seating etc. The difference was seen in the behavioural activity of wolf kept solo and wolves kept in a pack. Walking behaviour showed more weigh against eating behaviour. When wolf kept solo, it spent most of its time in running. The wolf was in stress because of the frequent presence of visitors near the cage. Sense of smell after that sense of hearing was most acute of the wolf's senses. When the wolf when kept solo, running and walking behaviour was mostly observed and another type of behaviour was observed less frequently. Twelve behaviours were regularly studied when wolf kept in pack. Wolves were found peacefully sharing food with one another. Sometime wolves show the scent roll behaviour. Facial behaviour was often used to express emotions. behaviour of wolves were affected by seasonal variations.

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REFERENCES

1. Aggarwal R. K. (2006). *Mitochondrial DNA coding region sequences support the phylogenetic distinction of two Indian wolf species*. *Journal of Black well Verlag, Berlin*. Pp: 163-172.
2. Dale. R & Range. F (2017). *The influence of social relationship on food tolerance in wolves and dogs*. *Behavior Ecology and Sociobiology*. Pp: 71: 107.
3. Goldman E. (1937). *The wolves of North America*. *Journal of Mammalogy*. Pp: 37-45.
4. Gunning N. (2007). *Welfare and conservation in captive canids: Analysis of enclosure use and general activity in socialized and unsocialized wolves (Canis lupus)*. *Department of Biological Sciences, University of Plymouth*. Pp: 1-33.
5. Habib B. (2007). *Ecology of Indian Wolf, Canis lupus pallipes and modeling its potential habitat in the great Indian bustard sanctuary, Maharashtra, India*. *PhD dissertation submitted to Aligarh Muslim University Aligarh-202 002, UP, India*.
6. Jhala Y.V. (2003). *Status, ecology and conservation of the Indian wolf Canis lupus pallipes*. *Journal of Bombay Natural History Society*.
7. Jhala Y.V. (2013). *Indian Wolf: Canis lupus pallipes* in John Singh, A.J.T., and N., Manjrekar, eds. 2013. *Mammals of South Asia*. Vol. 1. Hyderabad: Universities Press (India) Pvt Ltd.
8. Khandal D. & Khandal D. (2018). *Book of Ranthambhor. Dhonk*. Pp: 34-100.
9. Knuston C. (2017). *Influence of time spent in captivity on aggressive behaviors of gray wolves Canis lupus*. *Biology program. Bemidji state university*. Pp: 1-3.
10. Lawrence B. & Bossert W.H. (1967). *Multiple Character Analysis of Canis lupus, latrans, and familiaris, with a Discussion of the Relationships of Canisniger*. *American Zoologist* Vol. 7, No. 2, Pp: 223-232.
11. Mason G. J. (1991). *Stereotypies: a critical review*. *AnimalBehaviour*. Pp: 41- 60.

12. Mayura K. M., Habib B. and Kumar S. (2011). Food Habits of Indian Gray Wolf (*Canis lupus pallipes*) in Deccan Plateau of Maharashtra, India. *World Journal of Zoology* 6(3). Pp: 318-322.
13. Mech L.D. (1970). *The Wolf: The Ecology and Behavior of an Endangered Species*. University of Minnesota Press, Minneapolis.
14. Mech L. D. (1999). Alpha status, dominance, and division of labor in wolf packs. *Canadian Journal of Zoology* 77. Pp: 1196-1203.
15. Mech L.D. & Boitani L. (IUCN SSC Wolf Specialist Group) (2010). *Canis lupus*. The IUCN Red List of Threatened Species 2010: e.T3746A10049204.
16. Mech L.D. (1974). *Canis lupus*. *Mammalian species*, (37). Pp: 1-6.
17. Mendelssohn H. (1982). Wolves in Israel. [In: *Wolves of the world*. F. H. Harrington and P. C. Paquet, (Eds)]. Noyes Publications, Park Ridge, New Jersey. Pp: 173 - 195.
18. Montanaro A. (2012). *Wolves of Today*. Department of psychology. Wolf Conservation center. University of Bridgeport. Pp: 1.
19. Shreedevi, D., & Manimegalai, D. (2013). A comparative study of public and private non-life insurance companies in India. *International Journal of Financial Management (IJFM)*, 2(1), 13-19.
20. Muhammad S., Maqsood A., Mohammad S. and Zulfiqar A. (2015). Distribution range and population status of Indian gray wolf (*canis lupus pallipes*) and Asiatic jackal (*canis aureus*) in lehri nature park, Districk Jhelum, Pakistan. *Journal of Animal and Plant Sciences*. Pp: 433-440.
21. Nowak R.M. (2009). *Taxonomy, Morphology, and Genetics of Wolves in the Great Lakes Region*. in: *Recovery of Gray Wolves in the Great Lakes Region of the United States*, Eds. Wydeven, A. P., van Deelen, T. R., Heske, E. Publication: Springer-Verlag New York. Pp: 233-250.
22. Packard J.M. (2003). *Wolves: behavior, ecology and conservation*. The university of Chicago press, Chicago. Pp: 35-65.
23. Panov E.N. (1978). *Mekhanizmy kommunikatsii u ptits* (Communication Mechanisms in Birds), Moscow: Nauka.
24. Parker H.G, Kim LV, Sutter N.B, Carlson S, Lorentzen T.D, Malek T.B, Johnson G.S, DeFrance H.B, Ostrander E.A, Kruglyak L (2004) Genetic structure of the purebred domestic dog. *Science* 304. Pp: 1160–1164.
25. Raval H., Nayak J., Patel B. & Bhadesiya C. (2015). Zoonotic importance of leptospirosis in dogs: A research note on percentage analysis of knowledge level of dogs owners of 3 urban cities in Gujarat. *Journal of Lifescience leaflets*. 1 December 2015. Pp: 111-114.
26. Raval J. V. (2011). *Morphometric study of Bird's Nest*. *International journal of zoology research*. vol.1, Iss.2. Bioinfo publication. Pp: 30-35.
27. Reich D.E., Wayne, R.K., & Goldstein, D.B. (1999). Genetic evidence for a recent origin by hybridization of red wolves. *Molecular Ecology*. Pp: 139–144.
28. Roberts T. J. (1997). *The Mammals of Pakistan*. Oxford University Press. Pp: 525.
29. Salunkhe, H. A., & Deshmush, B. B. (2014). Impact Of Subsidy On Agriculture Sector In India-An Analytical Study. *International Journal of Agricultural Science and Research (IJASR)*, 4(2), 9-15.
30. Rothman R. J. & Mech L. D. (1979). Scent-marking in lone wolves and newly formed pairs. *Animal Behavior*.
31. Source: <https://www.google.co.in/maps/vt/data> Retrived on 14-1-2019 (Figure.4).

32. Source: <https://www.freeemaildatabase.com/product/meghalaya-free-email-database/> Retrived on 15-1-2019 (Figure.2).
33. Source: <https://www.researchgate.net/figure/a-Map-of-wolf-distribution-in-the-Northern-Hemisphere-showing-historical-distributions> Retrieved on 15-1-2019 (Figure. 1).
34. Source: [https://www. /states/gujarat/Sakkarbaug-zoological-garden-junagadh.html](https://www.states/gujarat/Sakkarbaug-zoological-garden-junagadh.html) Retrived on 14-1-2019.
35. Source: <http> Retrieved on 15-1-2019 (Figure.3).
36. Sagno L.N., Srivastav A. & Nigam P. (2017). *National Studbook of Indian Wolf (Canis lupus pallipes)* Central Zoo Authority Sponsored Project. Pp: 1-85.
37. Shahi P. S. (1982). Status of grey wolf (*Canis lupus pallipes*) in India. *Journal Bombay Natural History Society*. 79. Pp: 493-502.
38. Shepherdson D.J., Mellen J.D. & Hutchins M. (1998). *Second nature: environmental enrichment for captive animals*. Washington DC: Smithsonian Institution. Pp: 1–14.
39. Smith D.W. & D.R. Stahler (2003). *Management of habituated Wolves in Yellowstone National Park*. Yellow stone Center for Resources.
40. White A.B. (2001). Wild and captive wolf (*canis lupus*) aggression in relation to pack size and territory availability. *Environmental population and organismic biology*. Pp: 1-38.
41. Lakshmi, N. Diversity of wild greens knowledge from the rural households of anantapur district, AP.
42. Wielebnowski N. (1998). *Contribution of behavioral studies to captive management and breeding of rare and endangered mammals*. Oxford: Oxford University Press. Pp: 130–162.
43. Wozencraft W.C. (2005). Order Carnivora. In Wilson, D.E.; Reeder, D.M. *Mammal Species of the World: A Taxonomic and Geographic Reference* (3rd ed.). Johns Hopkins University Press. Pp: 575–577.
44. Yachmennikova A. & Poyarkov A. (2011). A new approach to study organization of wolves activity (*Canis lupus*) in time sequences. *Biology Bulletin*. Pg: 156-164.
45. Young P. & Goldman A. (1944). *The Wolves of North America*. 2. Dover Publications, New York. Pp: 413–477.

APPENDICES



Resting Behavior



Running Behavior



Frightened Behavior



Facial Behavior



Seating Behavior



Standing Behavior



Playing Behavior



Smelling Behavior



Sluggered Behavior



Walking Behavior



Resting Alert Behavior



Eating Behavior

